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Lung and Pancreatic Tumor Characterization in the Deep Learning Era: Novel Supervised and Unsupervised Learning Approaches

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Abstract: *Through computer-aided diagnostic (CAD) technologies, it is possible to characterize cancers from radiological pictures more accurately and quickly. As part of precision medicine, tumor characterisation using these technologies can also facilitate non-invasive cancer staging, prognosis, and individualized therapy planning. In order to enhance tumor characterisation, we suggest both supervised and unsupervised machine learning techniques in this work. We show notable improvements using deep learning algorithms for our first method, which is based on supervised learning, especially when using a 3D Convolutional Neural Network with Transfer Learning. We then demonstrate how to integrate task-dependent feature representations into a CAD system using a graph-regularized sparse Multi-Task Learning (MTL) framework, which is inspired by the radiologists' interpretations of the scans. In the second method, we investigate an unsupervised learning technique to solve a prevalent issue in medical imaging applications: the scarcity of labeled training data. We suggest using proportion-SVM to characterize tumors, which is inspired by learning from label proportion (LLP) techniques in computer vision. Additionally, we look for the answer to the fundamental question of whether "deep features" are good for unsupervised tumor classification. We test the state-of-the-art sensitivity and specificity findings in both the lung and pancreas tumor diagnosis challenges using 1018 CT and 171 MRI scans, respectively, to assess our suggested supervised and unsupervised learning techniques.*

Keywords: Unsupervised Learning, Lung cancer, 3D CNN, IPMN, Pancreatic cancer

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